J.J COLLEGE OF ENGINEERING AND TECHNOLOGY

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SOWDAMBIKAA GROUP OF INSTITUTIONS

ESTD. 1994

DEPARTMENT OF MECHANICAL ENGINEERING

CE3391 – FLUID MECHANICS AND MACHINERY

(Common to AERO)

QUESTION BANK

R - 2021

INSTITUTE VISION & MISSION

VISION:

To become a globally recognized "Centre of Academic Excellence" providing Quality Education to all students.

MISSION:

To provide Quality Education in the fields of Engineering, Management, Information, Technology and other Engineering areas.

DEPARTMENT VISION & MISSION

VISION:

To look for greatness in the field of Mechanical Engineering training through information and abilities to oblige the necessities of the general public.

MISSION:

M1 : To constantly improve the instructing and learning cycle to empower understudies to meet worldwide needs.

M2 : To redesign the information and abilities of understudies, individuals from personnel and supporting staff through standard training.

M3 : To produce the best personalities of specialists equipped for meeting assumptions for Industry, Society and Entrepreneurship improvement.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1	Effectuating success in careers by exploring with the design, digital and computational analysis of engineering systems, experimentation and testing, smart manufacturing, technical services, and research.
PEO2	Amalgamating effectively with stakeholders to update and improve their core competencies and abilities to ethically compete in the ever-changing multicultural global enterprise.
PEO3	To encourage multi-disciplinary research and development to foster advanced technology, and to nurture innovation and entrepreneurship in order to compete successfully in the global economy.
PEO4	To globally share and apply technical knowledge to create new opportunities that proactively advances our society through team efforts and to solve various challenging technical, environmental and societal problems.
PEO5	To create world class mechanical engineers capable of practice engineering ethically with a solid vision to become great leaders in academia, industries and society.

PROGRAM OUTCOMES (POs):

PO1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including the design of experiments, Analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply to reason in formed by the contextual Knowledge to assess societal, health, safety, legal and cultural issues and the Consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10	**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1	Apply the knowledge gained in Mechanical Engineering for design and development and manufacture of engineering systems.
PSO2	Apply the knowledge acquired to investigate research-oriented problems in mechanical engineering with due consideration for environmental and social impacts.
PSO3	Use the engineering analysis and data management tools for effective management of multidisciplinary projects.

CE3391	FLUID MECHANICS AND MACHINERY	L	T	P	C
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COURSE OBJECTIVES:

1. To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2. To impart basic knowledge of the dynamics of fluids and boundary layer concept.
3. To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
4. To exposure to the significance of boundary layer theory and its thicknesses.
5. To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT – I FLUID PROPERTIES AND FLOW CHARACTERISTICS 10+3

Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation – Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold's transportation theorem - Continuity equation, energy equation and momentum equation Applications.

UNIT - II FLOW THROUGH PIPES AND BOUNDARY LAYER 9+3

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT – III DIMENSIONAL ANALYSIS AND MODEL STUDIES 8+3

Fundamental dimensions - Dimensional homogeneity - Rayleigh's method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT – IV TURBINES 9+3

Impact of jets - Velocity triangles - Theory of rotodynamic machines - Classification of turbines - Working principles - Pelton wheel - Modern Francis turbine - Kaplan turbine - Work done - Efficiencies - Draft tube - Specific speed - Performance curves for turbines - Governing of turbines.

UNIT – V PUMPS 9+3

Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies– Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and its variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL: 60 PERIODS

COURSE OUTCOMES

On successful completion of this course, the student will be able to:	
CO1	Understand the properties and behaviour in static conditions. Also, to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics.
CO2	Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also, to understand the concept of boundary layer and its thickness on the flat solid surface.
CO3	Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies.
CO4	Explain the working principles of various turbines and design the various types of turbines.
CO5	Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps.

CO's – PO's & PSO's MAPPING

Correlation of COs with POs / PSOs														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	1	2	2	1	2	1	1	2	3	2	3
CO2	3	3	3	2	1	2	2	1	2	1	1	2	3	2	3
CO3	3	3	3	3	1	2	2	1	2	1	1	2	3	3	3
CO4	3	3	3	3	1	2	2	1	2	1	1	2	3	2	2
CO5	3	3	3	3	1	2	2	1	2	1	1	2	3	2	2
3 – High; 2 – Medium; 1 - Low															

TEXT BOOKS:

1. Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 22nd edition (2019)
2. Jain A. K. Fluid Mechanics including Hydraulic Machines, Khanna Publishers, New Delhi, 2014.
3. Kumar K. L., Engineering Fluid Mechanics, Eurasia Publishing House(p) Ltd. New Delhi, 2016.

REFERENCE BOOKS:

1. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2011.
2. Pani B S, Fluid Mechanics: A Concise Introduction, Prentice Hall of India Private Ltd, 2016.
3. Cengel Y A and Cimbala J M, Fluid Mechanics, McGraw Hill Education Pvt. Ltd., 2014.
4. S K Som; Gautam Biswas and S Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill Education Pvt. Ltd., 2012.
5. Streeter, V. L. and Wylie E. B., Fluid Mechanics, McGraw Hill Publishing Co., 2010.

UNIT – I

FLUID PROPERTIES AND FLOW CHARACTERISTICS

PART–A				
Q.No	**Questions**	**CO Mapping**	**BT Level**	**Complexity**
1	What are the properties of ideal fluid?	CO1	Understand	Medium
2	Define Weight density.	CO1	Remember	Low
3	What is specific gravity? How is it related to density?	CO1	Understand	Medium
4	Determine the specific weight and specific gravity of 1 litre of a liquid which weighs 7 N.	CO1	Create	High
5	Define Newton's law of Viscosity.	CO1	Remember	Low
6	Draw the shear stress-velocity gradient profile for Newtonian fluids.	CO1	Create	High
7	Differentiate compressible and incompressible fluids. Give suitable examples.	CO1	Understand	Medium
8	List some examples for Viscous fluid.	CO1	Remember	Low
9	Analyze Non-Newtonian fluids. Give suitable examples.	CO1	Analyze	Medium
10	Differentiate kinematic viscosity with dynamic viscosity.	CO1	Understand	Medium
11	Analyze the effect of temperature on viscosity of liquids and gases.	CO1	Analyze	Medium
12	Define surface tension.	CO1	Remember	Low
13	Define the term capillarity.	CO1	Remember	Low
14	What is meant by vapor pressure of a fluid?	CO1	Understand	Medium
15	What is the effect of cavitation?	CO1	Understand	Medium
16	Define steady and unsteady flow.	CO1	Remember	Low
17	What are the assumptions made in deriving continuity equation?	CO1	Understand	Medium
18	State the equation of continuity to three dimensional in steady flow.	CO1	Remember	Low

19	What are the assumptions of the Bernoulli's equations?	CO1	Understand	Medium
20	Justify the use of control volume.	CO1	Analyze	Medium

PART–B				
Q.No	**Questions**	**CO Mapping**	**BT Level**	**Complexity**
1	The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 m/s requires a force of 98.1 N to maintain the speed. Determine (i) Dynamic viscosity of the oil in poise. (ii) Kinematic viscosity of the oil in stokes if the specific gravity of the oil is 0.95.	CO1	Create	High
2	Explain various properties of fluids.	CO1	Understand	Medium
3	Explain various classifications of fluids with the help of a stress-strain graph. Give suitable examples.	CO1	Understand	Medium
4	A plate 0.025 mm distant from a fixed plate, moves at 60 cm/s and requires a force of 2 N/m^2 to maintain this speed. Determine the fluid viscosity between the plates.	CO1	Create	High
5	Calculate the capillary effect in millimeters in a glass tube of 4 mm diameter, when immersed in (i) water and (ii) mercury. The temperature of the liquid is 20°C and the values of the surface tension of water and mercury at 20°C in contact with air are 0.073575 N/m and 0.51 N/m respectively. The angle of contact for water is zero that for mercury is 130°. Take density of water at 20°C as equal to 998 kg/m3.	CO1	Create	High
6	Derive the continuity equation for three dimensional continuity flow in Cartesian coordinates.	CO1	Create	High
7	A pipe (1) 450 mm in diameter branches into two pipes (2) and (3) of diameters 300 mm and 200 mm respectively. If the average velocity in 450 mm diameter pipe is 3m/s. Find, (i). Discharge through 450 mm diameter pipe; (ii)Velocity in 200 mm diameter pipe if the	CO1	Create	High

	average velocity in 300 mm pipe is 2.5 m/s.			
8	Derive Bernoulli equation from Euler's equation of motion.	CO1	Create	High
9	The water flows through a pipe having diameters 20 cm and 10 cm at sections 1 and 2 respectively. The rate of flow through pipe is 35 litres/sec. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.24 N/cm², find the intensity of pressure at section 2.	CO1	Create	High
10	A 30 cm x 15 cm venturimeter is provided in a vertical pipe line carrying oil of specific gravity 0.9, the flow being upwards. The difference in elevation of the throat section and entrance section of the venturimeter is 30 cm. The differential U-tube mercury manometer shows a gauge deflection of 25 cm. Calculate: (a) The discharge of oil. (b) The pressure difference between the entrance section and the throat section. Take co-efficient of discharge as 0.98 and specific gravity of mercury as 13.6.	CO1	Create	High
11	A horizontal venturimeter with inlet and throat diameter 20 cm and 10 cm respectively is used to measure the flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 60 litres/sec. Find the reading of the oil - mercury differential manometer. Take Cd=0.98.	CO1	Create	High
12	A 45^o reducing bend is connected in a pipe line, the diameters at the inlet and outlet of the bend being 600 mm and 300 mm respectively. Find the force exerted by water on the bend if the intensity of pressure at inlet to bend is 8.829 N/cm^2 and rate of flow of water is 600 liters/s.	CO1	Create	High
13	A 300 mm diameter pipe carries water under a head of 20 m with a velocity of 3.5 m/s. If the axis of the pipe turns through 45^o, find the magnitude and direction of the resultant force at the bend.	CO1	Create	High
14	Derive the continuity equation in cylindrical polar co-ordinates.	CO1	Create	High

15	In a vertical pipe conveying oil of specific gravity 0.8, two pressure gauges have been installed at A and B where the diameters are 16 cm and 8 cm respectively. A is 2 meters above B. The pressure gauge readings at B is greater than at A by 0.981 N/cm². Neglecting all losses, calculate the flow rate. If the gauges at A and B are replaced by tubes filled with the same liquid and connected to a U-tube containing mercury, calculate the difference of level of mercury in the two limbs of the U-tube.	CO1	Create	High
16	The inlet and throat diameters of a horizontal venturimeter are 30 cm and 10 cm respectively. The liquid flowing through the venturimeter is water. The Pressure intensity at inlet is 13.734 N/cm² while the vacuum pressure head at the throat is 37 cm of mercury. Find the rate of flow. Assume that 4% of the differential head is lost between the inlet and throat. Find also the value of C_d for the venturimeter.	CO1	Create	High

UNIT – II

FLOW THROUGH PIPES AND BOUNDARY LAYER

PART–A				
Q.No	**Questions**	**CO Mapping**	**BT Level**	**Complexity**
1	Write down Hagen-Poiseuille equation for laminar flow.	CO2	Understand	Medium
2	Define equivalent diameter of a non- circular tube.	CO2	Remember	Low
3	Differentiate between T.E.L and H.G.L.	CO2	Understand	Medium
4	What are the conditions for a fluid to be hydraulically smooth?	CO2	Understand	Medium
5	Define the term Kinetic energy correction factor.	CO2	Remember	Low
6	Differentiate between laminar and turbulent flow.	CO2	Understand	Medium
7	What is equivalent pipe? Mention the equation used for it.	CO2	Understand	Medium
8	What is meant by boundary layer separations?	CO2	Understand	Medium
9	List four examples of laminar flow.	CO2	Remember	Low
10	Define boundary layer thickness.	CO2	Remember	Low
11	What is a syphon? Mention its applications.	CO2	Understand	Medium
12	Draw the velocity distribution and the shear stress distribution for the flow through circular pipes.	CO2	Create	High
13	What are the losses experienced by a fluid when it is passing through a pipe?	CO2	Understand	Medium
14	What do you mean by flow through parallel pipes?	CO2	Understand	Medium
15	Identify the applications of Moody's diagram.	CO2	Analyze	High
16	Write down the causes of minor energy losses in flow through pipes.	CO2	Understand	Medium
17	Define displacement thickness.	CO2	Remember	Low

18	Define momentum thickness.	CO2	Remember	Low
19	Give an expression of loss of energy due to sudden contraction and enlargement.	CO2	Understand	Medium
20	Define the terms Drag and lift.	CO2	Remember	Low

PART – B

Q.No	Questions	CO Mapping	BT Level	Complexity
1	Derive the expression for shear stress and velocity distribution for the flow through circular pipe and using that derive the Hagen Poiseuille formula.	CO2	Create	High
2	An oil of viscosity 0.1 Ns/m² and relative density 0.9 is flowing through a circular pipe of diameter 50 cm and of length 300 m. The rate of flow of fluid through the pipe is 3.5 litres/ Sec. Find the pressure drop in a length of 300 m and also the shear stress at the pipe wall.	CO2	Create	High
3	A liquid with a specific gravity 2.8 and a viscosity 0.8 poise flows through a smooth pipe of unknown diameter, resulting in a pressure drop of 800 N/m2 in 2 km length of the pipe. What is the pipe diameter if the mass flow rate is 2500 kg/hr.	CO2	Create	High
4	For the velocity profile in laminar boundary layer as u/U = 3/2 (y/δ) – 1/2 $(y/\delta$)3. Find the thickness of the boundary layer and shear stress, 1.5 m from the leading edge of a plate. The plate is 2 m long and 1.4 m wide is placed in water, which is moving with a velocity of 200 mm/sec. Find the total drag force on the plate if μ for water 0.01 poise.	CO2	Create	High
5	Find the head lost due to friction in a pipe of diameter 300 mm and length 50 m, through which water is flowing at a velocity of 3 m/s using (i) Darcy formula, (ii) Chezy's formula for which C = 60. Take v for water = 0.01 stroke.	CO2	Create	High
6	A horizontal pipe line 40 m long is connected to a water tank at one end discharge freely into atmosphere other end for the first 25 m of its length from the tank, the pipe is 150 mm diameter and its diameter is suddenly enlarged to 300 mm. The height of water level in the tank is 8 m above the center of the pipe. Considering all losses of head	CO2	Create	High

	which occur. Determine the rate of flow. Take f = 0.01 for both sections of the pipe.			
7	The rate of flow of water through a horizontal pipe is 0.25 m^3 /sec. The diameter of the pipe is suddenly enlarged from 200 mm to 400 mm. The pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine (i) loss of head due to sudden enlargement (ii) pressure intensity in the large pipe and (iii) power lost due to enlargement.	CO2	Create	High
8	Two reservoirs whose water surface elevations differ by 12 m are connected by the following horizontal compound pipe system starting from the high level reservoir. Take L1 =200 m, D1 =0.2 m, f1 = 0.008, and L2 = 500 m, D2 = 0.3 m, f2= 0.006. Considering all head losses and assuming that all changes of section are abrupt, compute the discharge through the system. Find the equivalent length of a 0.25 m diameter pipe if minor losses are neglected and friction factors are assumed to be the same. Sketch HGL and TEL.	CO2	Create	High
9	Three pipes of diameters 300 mm, 200 mm and 400 mm and lengths 450 m, 255 m and 315 m respectively are connected in series. The difference in water surface levels in two tanks is 18 m. Determine the rate of flow of water if coefficients of friction are 0.0075, 0.0078 and 0.0072 respectively considering: (a) Minor losses also and (b)Neglecting minor losses.	CO2	Create	High
10	A pipe line of length 2000 m is used for power transmission. If 110.3625 kW power is to be transmitted through the pipe in which water having a pressure of 490.5 N/cm^2 at inlet is flowing. Find the diameter of the pipe and efficiency of transmission if the pressure drop over the length of the pipe is 98.1 N/cm^2. Take f = 0.0065.	CO2	Create	High
11	The main pipe divides into two parallel pipes which again forms one pipe. The length and diameter for the first parallel pipe are 2000 m and 1.0 m respectively, while the length and diameter of 2nd parallel pipe are 2000 m and 0.8 m. Find the rate of flow in each parallel pipe, if total flow in the main is 3.0 m^3/s. The co-efficient of friction for each parallel pipe is same and equal to 0.005.	CO2	Create	High

12	Explain about minor losses and derive its expressions.	CO2	Create	High
13	A pumping plant forces water through a 600 mm diameter main, the friction head being 27 m. In order to reduce the power consumption, it is proposed to lay another main of appropriate diameter along the side of the existence one, so that two pipes may work in parallel for the entire length and reduce the friction head to 9.6 m only. Find the diameter of the new main if, with the exception of diameter, it is similar to the existing one in every respect.	CO2	Create	High
14	The velocity distribution in the boundary layer is given by $u/U = 2(y/\delta) - (y/\delta)2$, δ being boundary layer thickness. Calculate the following: i) Displacement thickness, ii) Momentum thickness, and iii) Energy thickness.	CO2	Create	High

UNIT – III
DIMENSIONAL ANALYSIS AND MODEL STUDIES

PART–A				
Q.No	**Questions**	**CO Mapping**	**BT Level**	**Complexity**
1	List the methods of dimensional analysis.	CO3	Remember	Low
2	What is Dimensional homogeneity?	CO3	Understand	Medium
3	State the advantages of Dimensional and model analysis.	CO3	Remember	Low
4	State and apply the significance Buckingham's π theorem	CO3	Remember	Low
5	What is meant by similitude?	CO3	Understand	Medium
6	Difference between Rayleigh's method and Buckingham's π theorem.	CO3	Understand	Medium
7	Develop the dimensions of the following Physical Quantities: (i) Pressure (ii) Surface Tension (iii) Dynamic viscosity (iv) Kinematic Viscosity	CO3	Create	High
8	What are the similarities between model and prototype?	CO3	Understand	Medium
9	Mention the circumstance which necessitates the use of distorted models	CO3	Remember	Low
10	Submarine is tested in the air tunnel. Identify the model law applicable.	CO3	Analyze	Medium
11	Define Froude's number and Euler's number.	CO3	Remember	Low
12	What is meant by undistorted model?	CO3	Understand	Medium
13	State the Fourier law of dimensional homogeneity.	CO3	Remember	Low
14	Mention the significance of Reynolds's model law.	CO3	Remember	Low
15	State the methods of dimensional analysis.	CO3	Remember	Low
16	How are the equations derived in Raleigh's method?	CO3	Understand	Medium

17	State three demerits of a distorted model.	CO3	Remember	Low
18	Develop the Euler model law and give its significance.	CO3	Create	High
19	Define Mach number and state its applications.	CO3	Remember	Low
20	Explain the different types of similarities that must exist between a prototype and its model.	CO3	Understand	Medium

PART – B

Q. No	Questions	CO Mapping	BT Level	Complexity
1	The resisting force (R) of a supersonic plane during flight can be considered as dependent upon the length of the aircraft 'l', velocity 'V', air viscosity 'μ', air density 'ρ' and bulk modulus of air is 'K'. Express the functional relationship between these variables and the resisting force.	CO3	Create	High
2	The power P developed by a water turbine depends on the rotational speed N, operating head H, gravity g, diameter D and width B of the runner, density ρ and viscosity μ of water. Show by dimensional analysis that $P = \rho D\ 5N\ 3\Phi$ [H/D, D/B, $\rho D^2N/\mu$, $ND/\sqrt{gH}$]	CO3	Create	High
3	The efficiency η of a fan depends on ρ (density), μ (viscosity) of the fluid, ω (angular velocity), d (diameter of rotor) and Q (discharge). Express η in terms of non-dimensional parameters. Use Buckingham's π theorem.	CO3	Create	High
4	Using Buckingham's π- theorem, show that the velocity through a circular orifice in a pipe is given by V= √2gH [D/H, μ/ ρvH] where v is the velocity through orifice of diameter d and H is the head causing the flow and ρ and μ are the density and dynamic viscosity of the fluid passing through the orifice and g is acceleration due to gravity.	CO3	Create	High

5	The pressure difference Δp in a pipe of diameter D and length l due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness. Using Buckingham's π theorem, obtain an expression for Δp.	CO3	Create	High
6	The power developed by hydraulic machines is found to depend on the head H, flow rate Q, density ρ, Speed N, runner diameter D and acceleration due to gravity g. Obtain suitable dimensionless parameters to correlate experimental results.	CO3	Create	High
7	The capillary rise h is found to be influenced by the tube diameter D, density ρ, gravitational acceleration g and surface tension σ, determine the dimensional parameters for the correlation of experimental results.	CO3	Create	High
8	Write short notes on the following i. Dimensionless Homogeneity with example. Euler Model Law. ii. Similitude. iii. Undistorted and Distorted Models.	CO3	Understand	Medium
9	Explain Reynold's law of similitude and Froude's law of similitude.	CO3	Understand	Medium
10	A Ship 300m long moves in sea water, whose density is 1030 kg/m^3, A1:100 model of ship is to be tested in a wind tunnel. The velocity of air in the wind tunnel around the model is 30m/s and the resistance of model is 60N. Determine the velocity of ship in sea water and also the resistance of the ship in sea water. The density of air is given as 1.24 kg/m^3. Take the kinematic viscosity of sea-water and air as 0.012 stokes and 0.018 respectively.	CO3	Create	High
11	A spillway model is to be built to a geometrically similar scale of 1/ 50 across a flume of 600 mm width. The prototype is 15 m high and the maximum head on it is expected to be 1.5 m (i). What height of model and what head of model should be used? (ii). If the flow over the model at a particular head is 12 litres per second, what flow per metre length of the prototype is expected? (iii). If the negative pressure in the model is 200 mm, what is the negative pressure in prototype? Is it practicable?	CO3	Create	High

12	The ratio of length of a submarine and its model is 30:1. The speed of submarine (prototype) is 10 m/s. The model is to be tested in a wind tunnel. Find the speed of air in wind tunnel. Also determine the ratio of the drag (resistance) between the model and prototype. Take the value of kinematic viscosities of sea water and air as 0.012 stokes and 0.016 stokes respectively. The density of sea water and air is given as 1030 kg/m3 and 1.24 kg/m3 respectively.	CO3	Create	High
13	The pressure drop in an aeroplane model of size 1/10 of its prototype is 80N/cm^2. The model is tested in water. Find the corresponding pressure drop in the prototype. Take density of air=1.24kg/m^3. The viscosity of water is 0.01 poise while the viscosity of air is 0.00018 poise.	CO3	Create	High
14	Derive the expressions for dimensionless numbers.	CO3	Create	High

UNIT – IV

TURBINES

PART–A				
Q.No	**Questions**	**CO Mapping**	**BT Level**	**Complexity**
1	Classify turbines according to flow.	CO5	Analyze	Medium
2	Define hydraulic efficiency of a turbine.	CO5	Remember	Low
3	What is cavitation?	CO5	Understand	Medium
4	Define specific speed of a turbine.	CO5	Remember	Low
5	Classify the different types of draft tubes.	CO5	Analyze	Medium
6	Define the terms: Hydraulic Machines, Turbines and Pumps.	CO5	Remember	Low
7	Define draft tube in Kaplan turbine.	CO5	Remember	Low
8	Illustrate an example for a low head turbine, a medium head turbine and a high head turbine.	CO5	Analyze	Medium
9	Differentiate the impulse and reaction turbine.	CO5	Understand	Medium
10	Draw the velocity triangle diagram for Pelton Wheel turbine.	CO5	Create	High
11	Write a note on performance curves of turbine.	CO5	Understand	Medium
12	Write a short note on Governing of Turbines	CO5	Understand	Medium
13	Define unit speed of a turbine.	CO5	Remember	Low
14	Define volumetric efficiency of turbine.	CO5	Remember	Low
15	Define the terms unit power, unit speed and unit discharge.	CO5	Remember	Low

PART–B				
Q.No	**Questions**	**CO Mapping**	**BT Level**	**Complexity**
1	Discuss about the hydroelectric power plant with neat sketch. Also explain various efficiencies.	CO4	Understand	Medium
2	Explain the constructional details of Pelton wheel with neat diagram.	CO4	Understand	Medium
3	A Pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 lps under a head of 30 m. The buckets deflect the jet through an angle of 160^o. Identify the power given by the water to the runner and the hydraulic efficiency of the turbine. Assume coefficient of velocity as 0.98.	CO4	Create	High
4	A Pelton wheel, working under a head of 500 m develops 13 MW when running at a speed of 430 rpm. If the efficiency of the wheel is 85 %, examine the rate of flow through the turbine, the diameter of the wheel and the diameter of the nozzle. Take speed ratio as 0.46 and coefficient of velocity for the nozzle as 0.98.	CO4	Create	High
5	A Pelton turbine is required to develop 9000 kW when working under a head of 300 m the impeller may rotate at 500 rpm. Assuming a jet ratio of 10 and an overall efficiency of 85% calculate (i) Quantity of water required, (ii) Diameter of the wheel, (iii) No of jets, (iv) No and size of the bucket vanes on the runner.	CO4	Create	High
6	Briefly explain the construction details of radial flow reaction turbine with neat sketch.	CO4	Create	High
7	A reaction turbine works at 450 rpm under a head of 120 m. Its diameter at inlet is 1.2 m and the flow area is 0.4 m^2. The angles made by absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Identify: (i) the volume rate of flow, (ii) the power developed, and (iii) the hydraulic efficiency. Draw the velocity triangle also. Assume whirl at outlet to be zero.	CO4	Create	High

8	Explain the working principle of Francis turbine with constructional details.	CO4	Understand	Medium
9	A Francis turbine with an overall efficiency of 75% is required to produce 148.25 KW. It is working under a head of 7.62 m. The peripheral velocity = 0.26 $\sqrt{2gH}$ and the radial velocity of the flow at inlet is 0.96 $\sqrt{2gH}$. The wheel runs at 150 rpm and the hydraulic losses in the turbine are 22% of the available energy. Assume radial discharge, determine. i) guide blade angle, ii) wheel vane angle at inlet, iii) diameter of wheel at inlet and iv) width of wheel at inlet. Draw the suitable velocity triangle.	CO4	Create	High
10	A hub diameter of a Kaplan turbine, working under a head of 12 m, is 0.35 times the diameter of the runner. The turbine is running at 100 rpm. If the vane angle of the runner at outlet is 15° and flow ratio 0.6, Examined (i) diameter of the runner, (ii) diameter of the boss, and (iii) Discharge through the runner. Take the velocity of whirl at outlet as zero.	CO4	Create	High
11	A Kaplan turbine develops 24647.6 kW power at an average head of 39 m. Assuming the speed ratio of 2, flow ratio of 0.6, diameter of the boss equal to 0.35 times the diameter of the runner and an overall efficiency of 90%, calculate the diameter, speed and specific speed of the turbine.	CO4	Create	High
12	A pelton turbine develops 3000kW under a head of 300m. The overall efficiency of the turbine is 83%. If the speed ratio =0.46, Cv = 0.98 and specific speed is 16.5, then find: (i) Diameter of the turbine (ii) Diameter of the jet.	CO4	Create	High

13	As inward flow reaction turbine has external and internal diameter as 1.0m and 0.6m respectively. The hydraulic efficiency of the turbine is 90% when the head on the turbine is 36m. The velocity of flow at outlet is 2.5 m/s and discharge at outlet is radial. if the vane angle at outlet is 150 and width of the wheel is 100mm at inlet and outlet, determine (i) the guide blade angle (ii) speed of the turbine (iii) vane angle of the runner at inlet (iv) volume flow rate of turbine (v) power developed.	CO4	Create	High
14	A Kaplan turbine runner is to be designed to develop 7357 KW shaft power. The net available head is 5.50m. Assume that the speed ratio is 2.09 and flow ratio is 0.68 and the overall efficiency is 60%. The diameter of the boss is 1/3 rd of the diameter of the runner. Find the diameter of the runner, its speed and its specific speed.	CO4	Create	High
15	A 137 mm diameter jet of water issuing from a nozzle impinges on the buckets of a pelton wheel and the jet is deflected through an angle of 1650 by the buckets. The head available at the nozzle is 400m. Assuming co-efficient of velocity as 0.97, speed ratio as 0.46 and reduction in relative velocity while passing through buckets as 15% find (i) The force exerted by the jet on buckets in tangential direction. (ii) The power developed.	CO4	Create	High
16	A propeller reaction turbine of runner diameter 4.5 m is running at 40 rpm. The guide blade angle at inlet is 1450 and runner blade angle at outlet is 250 to the direction of vane. The axial flow area of water through runner is 25 m^2. If the runner blade angle at inlet is radial determine: (i) Hydraulic efficiency of the turbine. (ii) Discharge through turbine. (iii) Power developed by the turbine (iv) Specific speed of the turbine.	CO4	Create	High

UNIT – V

PUMPS

PART–A				
Q.No	**Questions**	**CO Mapping**	**BT Level**	**Complexity**
1	What is the suction head of a pump?	CO5	Understand	Medium
2	Define mechanical efficiency of a pump.	CO5	Remember	Low
3	Why is the actual discharge greater than theoretical discharge in a reciprocating pump?	CO5	Understand	Medium
4	List the functions of an air vessel.	CO5	Remember	Low
5	What is the specific speed of a pump? How are pumps classified based on this number?	CO5	Understand	Medium
6	When does negative slip occur?	CO5	Understand	Medium
7	What are Roto dynamic pumps? Give examples.	CO5	Understand	Medium
8	What are the main components of reciprocating pump?	CO5	Understand	Medium
9	Define "Slip" of reciprocating pump. When does the negative slip occur?	CO5	Remember	Low
10	What are rotary pumps? Give examples	CO5	Understand	Medium
11	Define the manometric efficiency and mechanical efficiency of a pump.	CO5	Remember	Low
12	What is meant by NPSH?	CO5	Understand	Medium
13	What are the uses of indicator diagram?	CO5	Understand	Medium

PART–B				
Q.No	**Questions**	**CO Mapping**	**BT Level**	**Complexity**
1	(i) A jet of water of diameter 75 mm moving with a velocity of 25 m/s strikes a fixed plate in such a way that the angle between the jet and plate is 60°. Find the force exerted by the jet on the plate (i) in the direction normal to the plate and (ii) in the direction of the jet.	CO5	Create	High

	(ii) A jet of water of diameter 50 mm moving with a velocity of 40 m/s, strikes a curved fixed symmetrical plate at the Centre. Find the force exerted by the jet of water in the direction of the jet, if the jet is deflected through an angle of 120° at the outlet of the curved plate.			
2	A 7.5 cm diameter jet having a velocity of 30 m/s strikes a flat plate, the normal of which is inclined at 45° to the axis of the jet. Find the normal pressure on the plate: (i) When the plate is stationary. (ii) When the plate is moving with a velocity of 15 m/s and away from the jet. Also determine the power and efficiency of the jet when the plate is moving.	CO5	Create	High
3	A jet of water of diameter 50 mm moving with a velocity of 25 m/s impinges on a fixed curved plate tangentially at one end at an angle of 30° to the horizontal. Calculate the resultant force of the jet on the plate if the jet is deflected through an angle of 50°. Take g = 10m/s².	CO5	Create	High
4	Write the different classifications of rotary pumps and explain the working principle of gear pump with neat sketch.	CO5	Understand	Medium
5	Explain about the working principle of centrifugal pump with neat sketch.	CO5	Understand	Medium
6	The internal and external diameters of the impeller of centrifugal pumps are 200 mm and 400 mm respectively. The pump is running at 1200 rpm. The vane angles of the impeller at inlet and outlet are 20^o and 30^o respectively. The water enters the impeller radially and the velocity of flow is constant. Examine the work done by the impeller per unit weight of water. Sketch the velocity triangle.	CO5	Create	High
7	A centrifugal pump having an outer diameter equal to two times the inner diameter and running at 1000 r.p.m works against a total head of 40m. The velocity of flow through the impeller is constant and equal to 2.5 m/s. The vanes are set back at an angle of 40° at outlet. If the outer diameter of the impeller is 500 mm and width at outlet is 50mm, determine: i. Vane angle at inlet. ii. Workdone by impeller on water per second. iii. Manometric efficiency.	CO5	Create	High

8	Explain the working of a double acting reciprocating pump with a neat sketch.	CO5	Understand	Medium
9	The diameter and length of a suction pipe of a single acting reciprocating pump are 10 cm and 5 m respectively. The pump has a plunger diameter of 15 cm and a stroke length of 35 cm. The center of the pump is 3 m above the water surface in the sump. The atm. Pressure head is 10.3 m of water, and the pump runs at 50 rpm. Collect (Find), (i) pressure head due to Acceleration at the beginning of the suction stroke. (ii) Maximum pressure head due to Acceleration and (iii) pressure head in the cylinder at the beginning and end of the suction stroke.	CO5	Create	High
10	A double acting reciprocating pump has a bore of 150 mm and stroke of 250 mm and runs at 35 rpm. The piston rod diameter is 20 mm. The suction head is 6.5 m and the delivery head is 14.5 m. The discharge of water was 4.7 lit/s. Determine the slip and the power required.	CO5	Create	High
11	The diameter and width of a centrifugal pump impeller are 300 mm and 60 mm respectively. The pump delivers 144 litres of liquid per second with a manometric efficiency of 85%. The effective outlet vane angle is 30°. If the speed of rotation is 950 rpm. Calculate the specific speed of the pump.	CO5	Create	High
12	The cylinder bore diameter of a single acting reciprocating pump is 150 mm and its stroke is 300 mm. The pump runs at 50 r.p.m and lifts water through a height of 25 m. The delivery pipe is 22 m long and 100 mm in diameter. Find the theoretical discharge and the theoretical power required to run the pump. if the actual discharge is 4.2 liters/sec, find the percentage slip. Also determine the acceleration head at the beginning and middle of the delivery stroke.	CO5	Create	High

THANK YOU

ALL THE BEST